

# PATENT SPECIFICATION



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## COMPLETE SPECIFICATION

### Method of Welding Together Tubes and other Elements of Quartz, Hard Glass and other Refractory Materials

We, W. C. HERAEUS GESELLSCHAFT  
MIT BESCHRÄNKTER HAFTUNG, of Hanau-  
on-Main, Germany, a German Company,  
do hereby declare the nature of this in-  
5 vention and in what manner the same is  
to be performed, to be particularly de-  
scribed and ascertained in and by the  
following statement:—

When it is desired to join together two  
10 pieces of quartz, quartz glass and like  
tubing it is usually effected by suitably  
softening the ends to be joined, bringing  
the two parts together, and then treating  
the weld so formed by blowing and draw-  
15 ing, whereby a uniform wall thickness is  
obtained. This method has also been  
applied to fused silica in the form of  
quartz glass and quartz material, but,  
where large dimensions and wall thick-  
20 nesses are concerned, the method gives  
rise to difficulties, so that it is generally  
thought inadvisable to weld objects of  
quartz, quartz glass or like material,  
with wall thicknesses of more than 3  
25 millimetres.

The present invention has for its object  
to provide a method which will enable  
quartz and quartz-glass parts of large  
wall thicknesses to be welded together  
30 satisfactorily. According to the inven-  
tion, this object is achieved by making  
the connecting point in the form of a re-  
cessed joint of such depth that absolutely  
no, or only a small, wall thickness re-  
35 mains at its base. By this means, the  
welding flame is enabled not only to heat  
the entire cross-section sufficiently uni-  
formly and to a sufficiently high tem-  
perature, but also to soften the innermost  
40 portion of the wall. If additional mate-  
rial of the same kind is then introduced  
into the joint, in the form of grains or  
rods, it is possible, without great diffi-  
culty, to close the joint step by step, if,  
45 as is essential with large dimensions the  
two objects to be joined are secured in  
their relative positions. Since, in this  
case, only the joint itself need be heated,  
no deformation and thickening occur.  
50 Subsequent blowing and drawing opera-  
tions and mechanical treatment of the  
weld are therefore hardly necessary. On  
the other hand, with large dimensions

and wall thicknesses appropriate care in  
cooling is called for, and it is desirable,  
if possible, to stop up the cavities in close  
proximity to the weld, in order that dis-  
55 turbing air currents may be suppressed.

It is well-known *per se* to weld joints  
in quartz objects, but the methods 60  
hitherto employed differ substantially  
from the present method.

For instance, quartz rings have been  
made by welding together the ends of a  
bent quartz strip, by filling the joint with 65  
sand, and heating same both internally  
and externally. Furthermore, quartz  
plates have also been welded together by  
treating the surfaces to be united, bring-  
70 ing them into intimate contact and then  
heating them externally. In contradis-  
tinction to this, in the method according  
to the present invention the joint remains  
open, so that an electric arc or blowpipe  
75 flame can enter and directly heat the  
walls, and even with the maximum wall  
thickness raise them to temperatures even  
higher than can be obtained by external  
heating, whereby a better connection of  
the two parts to be joined results. 80

The new process is not restricted to  
materials which acquire a viscous semi-  
fluid condition in which they may be  
joined but can be applied to all materials  
which acquire sufficient strength merely 85  
by sintering. In this case, the additional  
material introduced into the joint is intro-  
duced in the form of more or less fine  
grains, preferably while the flame is ap-  
plied. In order to obtain the desired 90  
degree of sintering with such materials,  
either provision is made for matching the  
flame temperature to the grain size, as  
can be done, for instance, by varying the  
95 distance of the burner employed from the  
work, or by regulating the quantity of  
material supplied to the joint.

The value of the method lies in the  
fact that the assemblage of thick-walled  
vessels of glass, quartz glass, other quartz 100  
materials, corundum and other sinterable  
materials is now possible. For instance,  
tubes which could hitherto neither be  
manufactured nor conveyed in compara-  
tively great lengths can now be made as 105  
long as desired, and tubes of quartz mate-

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rial which hitherto had to be assembled from short pieces by means of sleeve connections can be combined into a closed tube without the introduction of sealed or packed joints.

An embodiment of the method according to this invention is diagrammatically illustrated in the accompanying drawing, by way of example, in which the single Figure shows in cross section the form of a joint at the commencement of operation. The parts 1 and 2 are the two parts to be joined and it can clearly be seen that the surfaces 3 and 4 thereof diverge from one another. 5 is an arc or blower flame which is directed between the surfaces 3 and 4.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Method of welding together parts of refractory weldable material which comprises forming a recessed joint between said parts, heating the opposed walls of the joint over their entire extent and in-

roducing additional material of the same kind as said parts into said joint while further heating same.

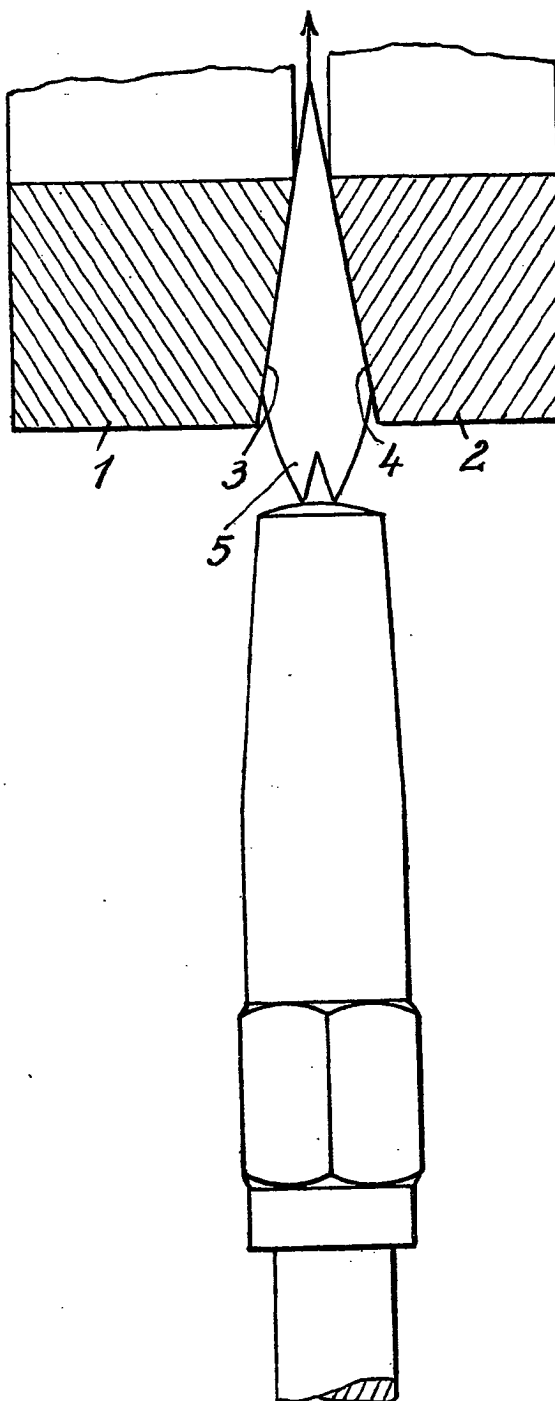
2. Method of welding together parts of refractory fusible material such as quartz, which comprises bevelling the surfaces to be united, bringing said bevelled edges together, heating the opposed surfaces of said bevelled edges over their entire extent and introducing further material of the same kind into the space enclosed between said edges while supplying further heat thereto.

3. As an article of manufacture, two parts of refractory fusible material such as quartz united by a welded joint, said joint being formed between opposed bevelled surfaces of said parts, the space between which is filled with material of a like kind to said parts intimately connected to the walls of said joint over the entire extent thereof.

Dated this 24th day of December, 1935.

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Chartered Patent Agent.

*[This Drawing is a full-size reproduction of the Original.]*



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